

BRH DEP 70-9
PB191906

PRODUCT TESTING AND EVALUATION OF GIANT VIEW[®] TV PROJECTOR

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va. 22151

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

32

DIVISION OF ELECTRONIC PRODUCTS

List of Publications

The following reports published as part of this series by the Division of Electronic Products, Bureau of Radiological Health, are available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Price is \$3.00 for paper copy and \$0.65 for microfiche. The PB number, if indicated for a report, should be cited when ordering.

Title

TSB-1	Instrument for Measurement of X-ray Emission from Television Sets (January 1968)	PB 178 808
TSB-2	A Pilot Survey of X-radiation Emissions from Color Television Receivers (In Pinellas County, Florida) (June 1968)	PB 178 809
TSB-3	A Survey of X-radiation from Color Television Sets in the Washington, D.C. Metropolitan Area (March 1968)	PB 178 810
TSB-68-4	Biological Aspects of Microwave Radiation - A Review of Hazards (July 1968) (Reprinted August 1969)	PB 185 964
TSB-5	Report of Preliminary Measurements of Electromagnetic Radiation Fields Near Microwave Ovens (December 1968)	PB 185 967
DEP 69-1	X-radiation Control Programs in the Color Television Industry - Summary Report on Visits to Manufacturers - May 1968-December 1968 (March 1969)	PB 185 979
DEP 69-2	A Field Method for the Determination of Lead in Glass Used for Shielding Television Receiver Components (December 1969)	PB 188 703
BRH/DEP 70-1	X-ray Emission from Cold-Cathode Gas Discharge Tubes Used for Educational Purposes (February 1970)	PB 189 890
BRH/DEP 70-2	Report of Tests Made on the Westinghouse Panoramix [®] X-ray Machine (March 1970)	PB 190 870
BRH/DEP 70-3	Description and Evaluation of a Fluoroscopic Screen Visual Brightness Comparer (March 1970)	PB 190 399
BRH/DEP 70-4	Evaluation of a Norelco-Pitchford Portaspec [®] Portable X-ray Spectrograph (March 1970)	PB 190 876
BRH/DEP 70-5	A Study of Head and Neck Exposures from Panoramix [®] Roentgenography (March 1970)	PB 190 964
BRH/DEP 70-6	Laboratory Testing and Evaluation of Color Television Receivers Acquired During the In-Plant Survey (March 1970)	PB 191-090
BRH/DEP 70-7	A Comparison of Microwave Detection Instruments (April 1970)	
BRH/DEP 70-8	Development of Liquid Crystal Microwave Power Density Meter (May 1970)	

BRH/DEP 70-9

**PRODUCT TESTING
AND EVALUATION
OF GIANT VIEW[®]
TV PROJECTOR**

Paul S. Ruggera

**Product Testing and Evaluation Branch
Division of Electronic Products**

May 1970

**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
Bureau of Radiological Health
Rockville, Maryland 20852**

The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products by the Department of Health, Education, and Welfare, Public Health Service.

FOREWORD

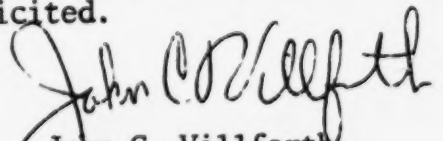
The Bureau of Radiological Health, formerly the National Center for Radiological Health, continues to carry out a national program designed to reduce the exposure of man to hazardous ionizing and non-ionizing radiation.

Within the Bureau, the Division of Electronic Products (1) develops and administers performance standards for radiation emissions from electronic products, (2) studies and evaluates emissions of and conditions of exposure to electronic product radiation and intense magnetic fields, (3) conducts or supports research, training, development, and inspections to control and minimize such hazards, and (4) tests and evaluates the effectiveness of procedures and techniques for minimizing such exposures.

The Bureau publishes its findings in Radiological Health Data and Reports (a monthly publication), the Environmental Health Series, Public Health Service numbered reports, appropriate scientific journals, and Division and Laboratory technical reports.

The technical reports of the Division of Electronic Products (DEP) allow comprehensive and rapid publishing of the results of intramural and contractor projects. The reports are distributed to State and local radiological health program personnel, Bureau technical staff, Bureau advisory committee members, university radiation safety officers, libraries and information services, industry, hospitals, laboratories, schools, the press, and other interested individuals. These reports are also included in the collections of the Library of Congress and the Clearinghouse for Federal Scientific and Technical Information.

I encourage the readers of these reports to inform the Bureau of any omissions or errors. Your additional comments or requests for further information are also solicited.

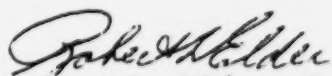

John C. Villforth
Director
Bureau of Radiological Health

PREFACE

The "Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) effective October 18, 1968, provides that the Secretary of Health, Education, and Welfare shall "study and evaluate emission of and conditions of exposure to electronic product radiation."

In order to control the emission of x radiation in electronic products, proper shielding of the high voltage components is necessary. Effective shielding can be accomplished by either of two methods. The most common practice is to externally intercept the x-ray beam with high atomic number material. In dealing with component parts, however, it is also possible to incorporate this shield into its initial construction (e.g., using leaded glass in electron tube envelopes).

This report presents x-radiation data recorded from the kinescope of a projection television unit. The model tested had a moveable kinescope housing which, when extended, essentially removed the shielding effect of the cabinet. Measurements were made under typical operating conditions, and these were related to the two extremes of kinescope position. In addition, a leaded kinescope of the same type was substituted, and data showing the relationship between the lead content of the glass envelope and the emission rate are reported.



Robert L. Elder, Sc.D.
Acting Director
Division of Electronic Products

CONTENTS

	Page
FOREWORD.	iii
PREFACE	v
ABSTRACT.	ix
1. INTRODUCTION.	1
2. INSTRUMENTATION AND CALIBRATION	5
3. TEST RESULTS.	5
3.1 LOCATION OF SOURCE OF RADIATION.	6
3.2 RADIATION MEASUREMENTS--OPTICAL HOUSING OUTSIDE CABINET.	6
3.3 RADIATION MEASUREMENTS--OPTICAL HOUSING INSIDE CABINET	12
4. REPLACEMENT KINESCOPE	15
4.1 RADIATION MEASUREMENTS--OPTICAL HOUSING OUTSIDE CABINET.	15
4.2 RADIATION MEASUREMENTS--OPTICAL HOUSING INSIDE CABINET	19
5. ANALYSIS OF DATA.	19
6. CONCLUSIONS AND RECOMMENDATIONS	20
REFERENCES.	23

FIGURES

	Page
1. Giant View TV projector: optical housing outside cabinet, optical housing side of unit.	2
2. Giant View TV projector: optical housing inside cabinet, optical housing side of unit.	3
3. Giant View TV projector: upper door closed, operator's side of unit	4
4. Slit-film technique	7
5. Area of uniform intense x radiation: optical housing outside cabinet; original kinescope	8
6. Exposure rate as a function of distance from the optical housing: optical housing outside cabinet, original kinescope.	13
7. Area of uniform intense x radiation: optical housing inside cabinet, original kinescope	14
8. Exposure rate as a function of distance from the optical housing: optical housing inside cabinet, original kinescope	16
9. Area of uniform intense x radiation: optical housing outside cabinet, replacement kinescope.	17
10. Exposure rate as a function of distance from the optical housing: optical housing inside cabinet, replacement kinescope	18
11. Closeup of optical housing.	21
12. Giant View TV projector: upper door open, operator's side of unit.	22

ABSTRACT

This report presents x-radiation data recorded from the kinescope of a projection television unit. The model tested had a moveable kinescope housing which, when extended, essentially removed the shielding effect of the cabinet. Measurements were made under typical operating conditions, and these were related to the two extremes of kinescope position. In addition, a leaded kinescope of the same type was substituted, and data showing the relationship between the lead content of the glass envelope and the emission rate are reported.

BLANK PAGE

PRODUCT TESTING AND EVALUATION OF GIANT
VIEW® TV PROJECTOR

1. INTRODUCTION

In the summer of 1969, the radiation safety officer for Ohio University made a report to the Division of Electronic Products in which he presented test results showing high x-radiation emission from a Giant View® TV projector unit. His description of the unit was as follows:

"The projection system is used to project a television program onto a large motion picture screen, which may be viewed by a large group of individuals. The position of individuals, while viewing, may be in the following locations; front of unit, back of unit, and on the sides of the unit. Possible uses of the system are academic class instruction, viewing of sport events, political programs (elections), closed circuit academic debates, business meetings, entertainment, and national defense."

Figures 1 and 2 indicate the primary features and relative size of the unit. The optical housing, which contains the cathode-ray tube (CRT), a reflective mirror, and a lens, can be located in several positions when the unit is in use. The two extreme positions are shown in figures 1 and 2. In addition to the optical housing, the cabinet holds the tuner, audio and video section, low-voltage power supply, sweep circuitry and high-voltage power supply. Each of the sections has adjustable user controls similar to those in a standard television set. The only difference is that they are located on the opposite side of the unit. Since the unit projects an image, the user does not view the CRT while making these adjustments as one does in a standard television set. A picture of the controls is shown in figure 3. In order to clarify location of radiation areas throughout the discussion, it was necessary to refer to these areas as: optical housing side (figures 1 and 2) and operator's side (figure 3).

Based on the Ohio University report, the Intelligence Branch of the Division of Electronic Products decided to investigate the problem using calibrated instrumentation. When field trip results confirmed the high-

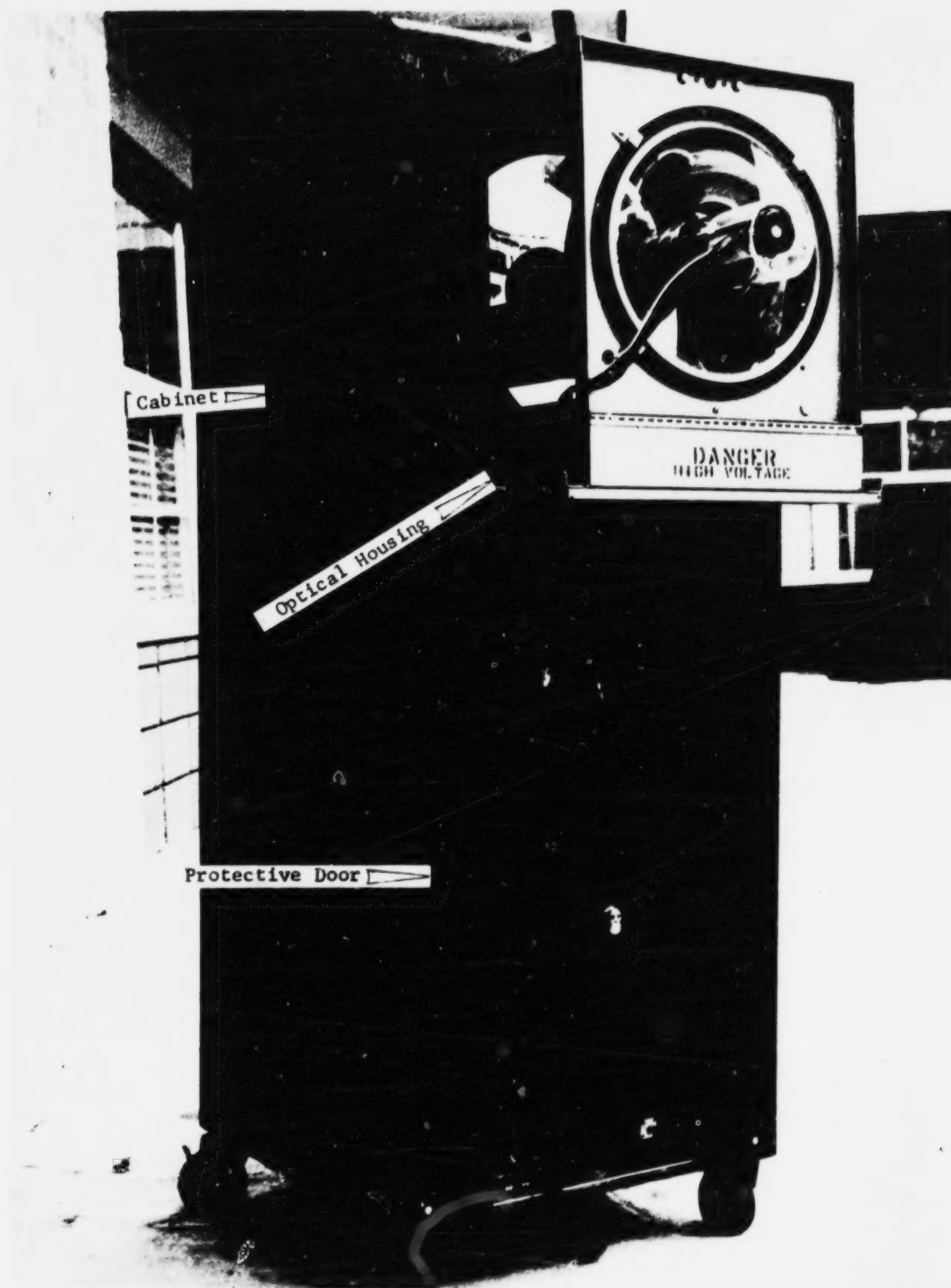


Figure 1. Giant View TV projector: optical housing outside cabinet,
optical housing side of unit



Figure 2. Giant View TV projector: optical housing inside cabinet,
optical housing side of unit

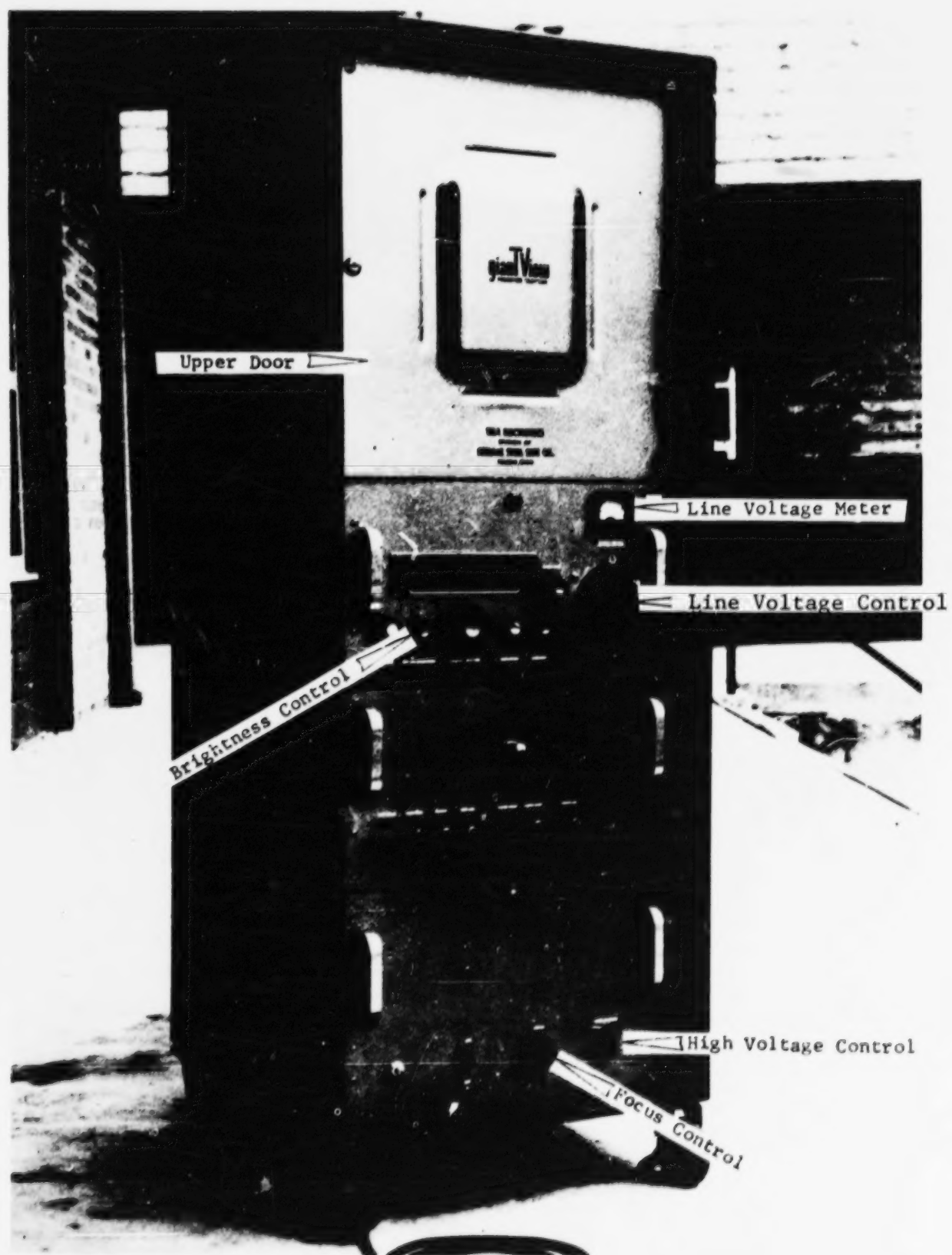


Figure 3. Giant View TV projector: upper door closed, operator's side of unit

emission capability of the projector, arrangements were made to borrow the projector so that the Product Testing and Evaluation Branch could perform a more extensive study.

The unit arrived in late September 1969. The projector, Model 912A, was manufactured by Television Electronics Division of the Meilink Steel Safe Company prior to 1964. Visual inspection showed the unit was not in sound mechanical condition. Due to the age of the unit and wear and tear, it was not possible to slide the optical housing into the cabinet to close a protective door. The instruction manual supplied with the unit was followed during unpacking and assembly. After some tubes were replaced in their sockets, the unit was believed to be operational. The manual focus as well as the electric focus adjustments were made as described in the manual in order to operate under recommended conditions.

2. INSTRUMENTATION AND CALIBRATION

The instrumentation used to measure the radiation and other variables was as follows:

- Weston Model 904 Voltmeter
- Hallmark KVE Electrostatic Kilovoltmeter
- Victoreen Model 444 Survey Meter
- Victoreen Model 440 RF Survey Meter
- Victoreen Model 440 RF/C Survey Meter
- Leader Electronics Corporation Model 388 Color Bar Generator
- Simpson Model 1327 D.C. Milliammeter
- Duo-Ready Pack, Eastman Kodak Type 50142, Type 50125

The ammeters and voltmeters were calibrated against suitable standards by the Radiation Measurements and Calibration Branch of the Division of Electronic Products. The Victoreen 444 and 440 RF were standardized with a Victoreen Model 401 free-air ion chamber over a range of 25 keV to 50 keV and half-value layers of aluminum from 0.77 mm to 3.90 mm. The Victoreen 440 RF/C was calibrated by the manufacturer.

3. TEST RESULTS

Since the manufacturer was very clear in presenting the recommended line voltage range of 117 to 120 volts and provides a meter and variable transformer so that these recommendations can be met, all tests were conducted within these limits. Furthermore, to ensure constancy and reproducibility, a signal generator, using a small crosshatch pattern was used throughout the tests for the input signal.

3.1 LOCATION OF SOURCE OF RADIATION

A preliminary survey with the Victoreen 444 indicated that a broad band of high-intensity x radiation was present at the sides of the optical housing. In order to determine the location of the actual source relative to the optical housing, it was decided to use a film-grid technique developed by the Division of Electronic Products (1). This technique also defines the area of maximum exposure at the same time. Multiple slit plates were etched from glass-epoxy copper-clad board. Solder was placed on the board to provide additional shielding. The slits averaged 0.2 cm by 5 cm with approximately 50 slits per board. The plate was located on both sides of the optical housing, and the film packs were positioned so that the 14-inch edges were against the slits (see figure 4). The exposure duration was 10 minutes.

Once the films were developed, a composite picture was made of the film and a drawing of the housing and kinescope. Since the critical distances were known, a two-dimensional path was extended from the rays on the film to the structure at which they intersected. The source of radiation was thus defined as the faceplate of the kinescope. The result of this procedure is shown in figure 5. Relative to the plane of the tube face, the area of maximum emission is present in a band of 20° arc, starting at approximately 9° and diminishing at approximately 30°. When the radiation meters were placed in this region, the readings were repeatable as long as the distance to the source did not change. For this reason, the center line of the arc areas was followed in the subsequent determination of distance versus radiation. It can be seen that this area becomes 30 inches wide at a distance of three feet, whereas it is 4 inches wide at the surface of the housing.

3.2 RADIATION MEASUREMENTS--OPTICAL HOUSING OUTSIDE CABINET

The unit is capable of producing a clear, nonfluttering picture at several different combinations of control settings. Since the best picture resulted when the contrast control was turned to its maximum, it was left there throughout all tests (this condition also resulted in maximum radiation emission). The radiation emission was also maximized by adjusting the brightness and focus controls alternately to maintain a good picture and still operate with the highest voltage on the kinescope. This occurred below maximum brightness.

Before any quantitative data were taken, the 440 RF and the 444 instruments were compared to see if any radiofrequency interference was present at the various readings. To do this, the projector was set at maximum emission conditions, and the meters were placed in identical positions in the path. Table 1 compares these readings. These results indicated that radiofrequency interference was not a major factor in the measurements. Since the 444 can measure the higher levels nearer the unit, it was selected as the primary radiation instrument.

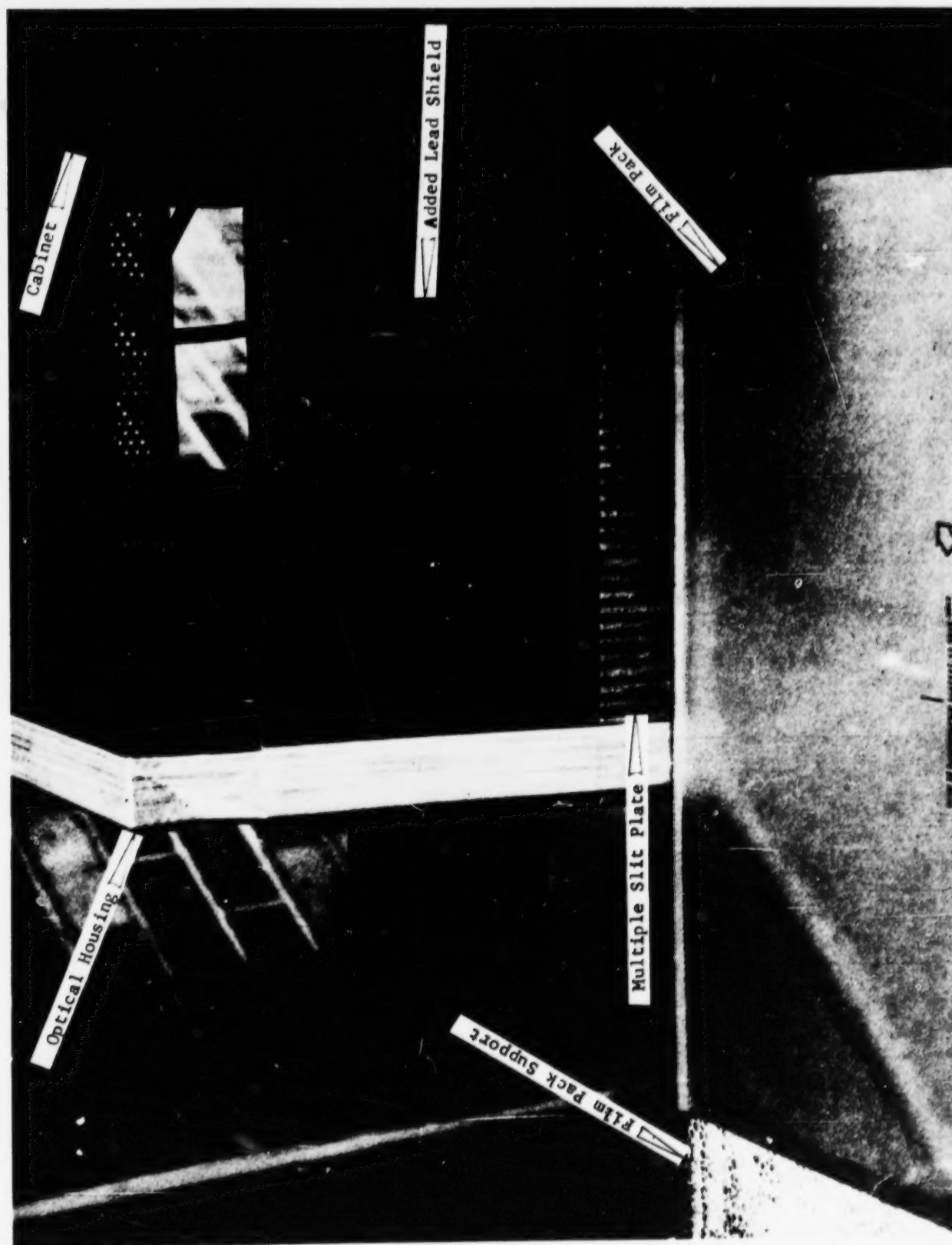


Figure 4. Slit-film technique

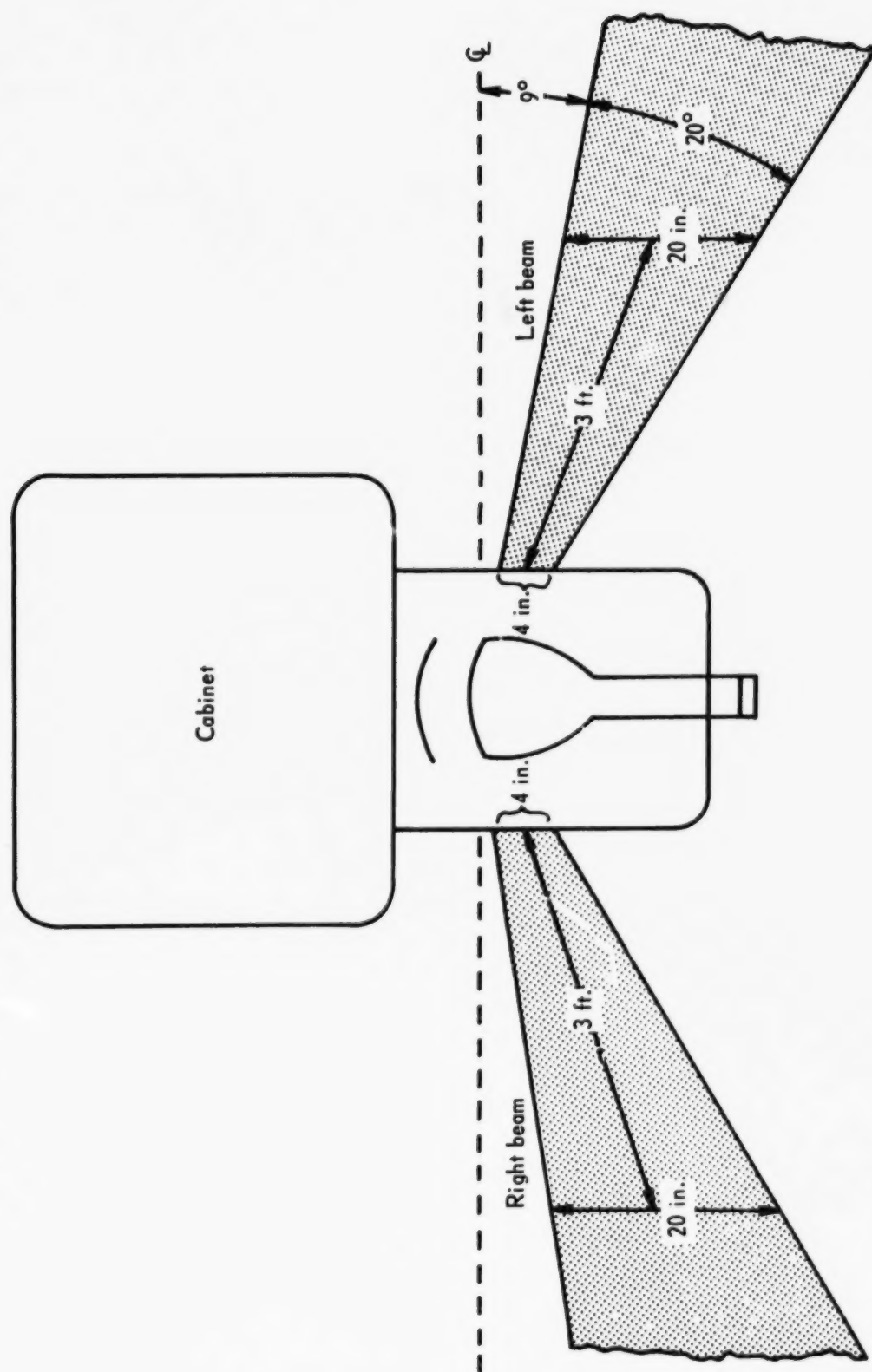
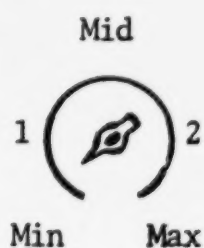


Figure 5. Area of uniform intense x radiation: optical housing outside cabinet, original kinescope

Table 1. - Radiation measurements comparing the 444
and 440 RF instruments

Distance from unit (inches)	440 RF (mR/hr)	444 (mR/hr)
12-1/2	250	250
16	200	200
25	100	100
38	50	46
55	26	25
76-1/2	12	11-1/2

Table 2 presents the regulation data and radiation measurements from the right side of the housing, whereas table 3 presents data from the left side when one projects an image and views the screen. The data show the close correspondence between the radiation levels on both sides. As mentioned earlier, all of these combinations produce a stable picture; therefore, it is unrealistic to believe that the unit was producing maximum radiation each time it was operated. It should be noted, however, that the manufacturer does suggest that the high-voltage controls be set at the maximum (fully clockwise). All measurements were made at a distance of 2 inches from the optical housing on either side. The high-voltage knob setting can be interpreted by the following diagram.



From the tables the maximum exposure rate, observed at 2 inches from the optical housing from both sides of the tube, was 800 mR/hr; the minimum was 4.8 mR/hr on the left side. In generating tables of this type there are many variables -- line voltage, high voltage, level of brightness, and radiation measurement. It was decided to adjust for the highest obtainable radiation level on the right side first and generate table 2, varying only those controls which could be carefully

Table 2. Right side regulation data with original tube and optical housing outside the cabinet

High voltage control position	Line voltage (volts)	Kinescope current (milliamperes)	Kinescope voltage (kV)	X radiation (mR/hr at 2 inches)
MAX	120	0.58	32.5	800
	119	0.56	32.5	770
	118	0.56	32.2	730
	117	0.56	31.8	700
2	120	0.52	27.2	175
	119	0.52	27.2	175
	118	0.52	27.2	180
	117	0.52	27.2	185
MID	120	0.44	22.0	14
	119	0.43	22.0	14
	118	0.43	21.9	14
	117	0.42	21.9	14
Half Way Between 1 & MID	120	0.39	20.5	5
	119	0.40	20.4	5
	118	0.41	20.4	5
	117	0.42	20.4	5

Table 3. Left side regulation data with original tube and optical housing outside the cabinet

X radiation (mR/hr at 2 inches)	Kinescope voltage (kV)	Kinescope current (milliamperes)	Line voltage (volts)	High voltage control position
800	33.2	0.50	120	MAX
790	33.1	0.51	119	
770	32.9	0.51	118	
720	32.7	0.51	117	
140	26.9	0.47	120	2
142	26.9	0.47	119	
145	27.0	0.47	118	
145	27.0	0.47	117	
12	22.1	0.40	120	MID
12	22.0	0.41	119	
12	22.1	0.40	118	
11	22.0	0.40	117	
5	20.7	0.57	120	Half Way Between 1 & MID
5	20.6	0.40	119	
5	20.5	0.40	118	
5	20.7	0.39	117	

set -- the high voltage and the line voltage. The Victoreen 444 was then moved to the left side and table 3 was generated in the same manner, beginning with the maximum emission condition. This explains why the high voltage and tube current, both of which are somewhat controlled by the brightness, were not identical even though the maximum x-ray exposure rate was 800 mR/hr from both sides. The difference in x-radiation emission comparing left and right sides was considered negligible, and the following distance versus radiation data were taken only from the right side (see figure 6).

To determine the maximum rates of exposure found at various distances from the planar-type source, the unit was set up to produce maximum emission as found in table 2. The Victoreen 444 was then moved along the bisected arc of maximum radiation (defined in figure 5) as far away from the source as was physically possible within laboratory space limitations. Figure 6 shows the results of radiation versus distance from 1-1/2 inches to 76-1/2 inches. The fact that it is not a point source of radiation is verified by the curvature observed as the distance to the source was decreased. The maximum exposure rate was found to be above 800 mR/hr near the surface of the housing; the minimum recorded at 6.3 feet was 11-1/2 mR/hr. Referring to figures 5 and 6, it can be shown that at the 3-foot mark, the beam is 20 inches wide and the exposure rate is approximately 55 mR/hr. The vertical extent of the beam from the sides is confined by the metal plates on the top and bottom of the unit. Measurements three feet from the unit showed a vertical field sufficient to irradiate a man from head to foot.

Although most tests were made in the maximum radiation beam, it should be noted that the Victoreen 444 showed the presence of x radiation when placed anywhere on the side surfaces of the optical housing. Also, an exposure rate of 80 mR/hr was measured 2 inches from the top surface of the optical housing above the face of the tube; 50 mR/hr was recorded 2 inches from the bottom surface, and 35 mR/hr was recorded through the lens assembly on front. From the operator's side (shown in figure 3) with the upper door closed, 1.5 mR/hr was measured in the center of the door at 2 inches from the surface; 6 mR/hr was measured in the same place with the door open.

3.3 RADIATION MEASUREMENTS -- OPTICAL HOUSING INSIDE CABINET

With the optical housing in this position (figure 2), the unit was surveyed to determine how the increased metal introduced by the cabinet walls affected the area of emission. Figure 7 shows the maximum emission paths found when the housing was in the cabinet. The slit-film technique was not needed here since there is only a 2-inch air gap on either side of the lens viewing the optical housing side of the unit, and this defines the beams very well when using the 444 and 440 RF/C for location. Again, the right side (when viewing the screen) produced a higher exposure

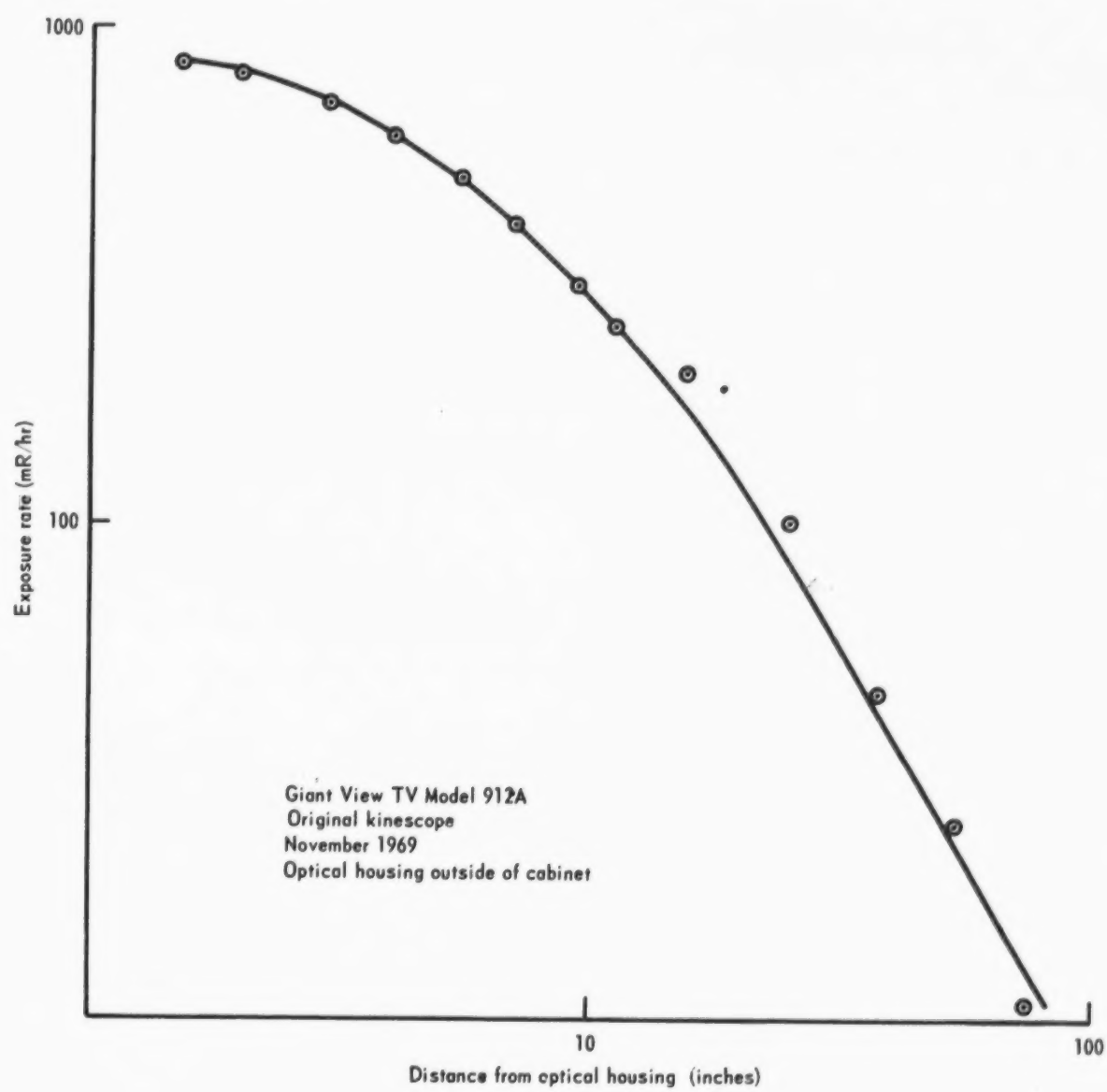


Figure 6. Exposure rate as a function of distance from the optical housing:
optical housing outside cabinet, original kinescope

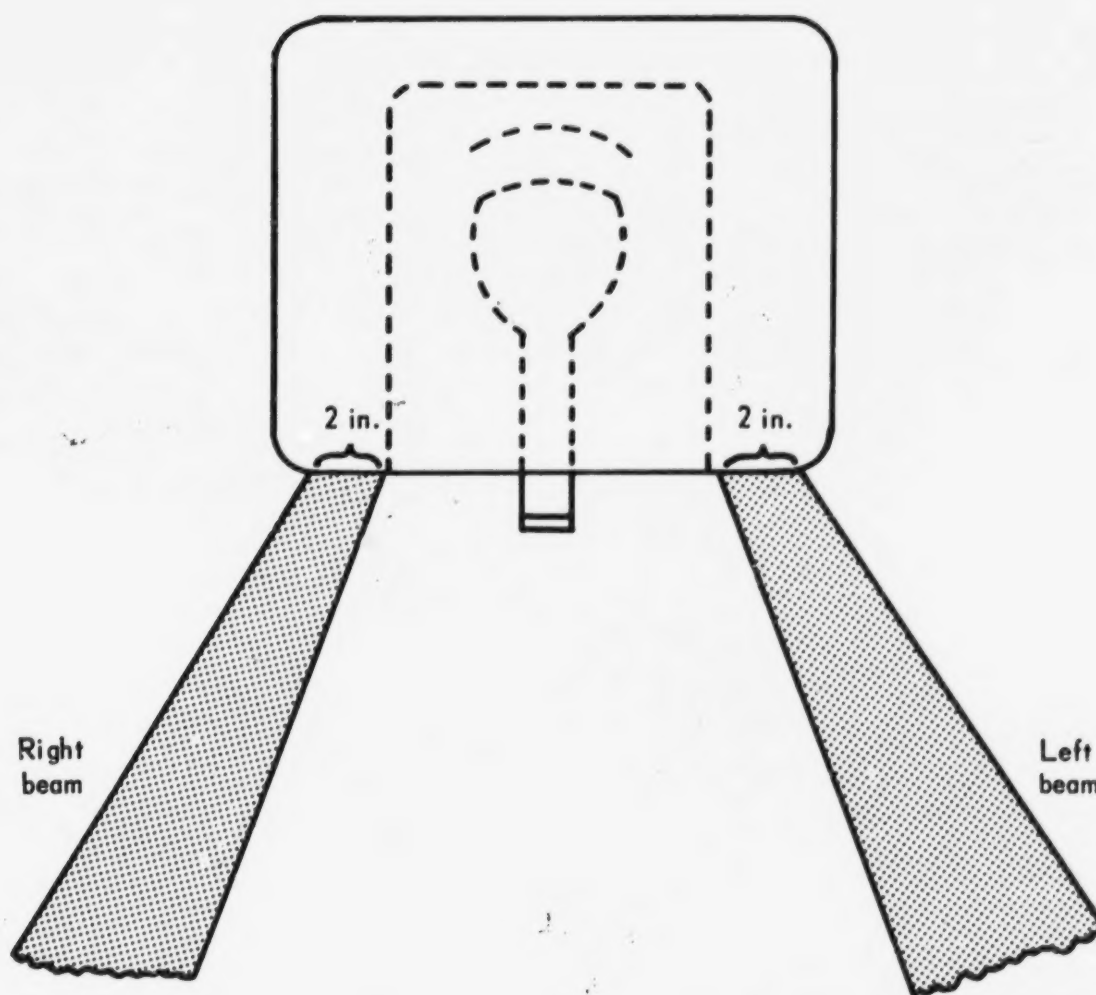


Figure 7. Area of uniform intense x radiation: optical housing inside cabinet, original kinescope

rate of 80 mR/hr 2 inches from the opening, whereas the radiation from the left side was 50 mR/hr. Figure 8 shows the results when the 444 was moved away from the source. It was obtained in the same manner as figure 6. The lowest value recorded was 1.2 mR/hr at 9.6 feet from the unit.

A survey of the unit in this position at 2 inches from the surface showed additional regions of exposure as follows: 4 mR/hr from each speaker hole; 4.8 mR/hr on operator's side at the center of the closed upper door; 15 mR/hr on operator's side, center upper door open; and 35 mR/hr from the lens surface as found before. The higher rates of exposure at the operator's side were as expected since the source is closer when the optical housing is in the cabinet.

4. REPLACEMENT KINESCOPE

During the course of the testing, a plug from the underside of the chassis fell out and the sweep circuit was lost. An area of phosphor was subsequently burned off the kinescope. While the missing phosphor had no observable affect on the radiation emission rate, it did show up in the center of the screen, and since the unit was on loan, a new kinescope was purchased.

4.1 RADIATION MEASUREMENTS --OPTICAL HOUSING OUTSIDE CABINET

When the new kinescope was installed and operated, a substantial reduction was found in both the areas and magnitude of radiation (see figure 9). By using the technique described in "A Field Method for the Determination of Lead Content in Glass Used for Shielding Television Receiver Components" (2), it was found that the CRT funnel of the new tube contained 30-35 percent lead, whereas the old tube showed no lead content. The faceplates showed no lead content when tested. The tube manufacturer has informed the Division of Electronic Products that as of November 1, 1969, all funnels are being made from the lead glass in the production of the kinescope. Table 4 was generated in the same manner as table 2, and data were taken only from the right side of the optical housing. Note the significant drop in radiation.

When the high-voltage control was at midposition or below, no radiation was detected. Figure 10 shows the exposure rate in mR/hr as a function of distance from the surface when the new tube was in the maximum operating condition. The minimum value recorded was 0.5 mR/hr at a distance of 80 inches from the unit. The maximum value recorded 2 inches from the top and bottom surfaces of the optical housing was 15 mR/hr. With the upper door closed on the operator's side, 1.8 mR/hr was recorded in the center; the value increased to 6.3 mR/hr with the door open. These values are higher than those found from the original tube, indicating that the operator would receive slightly greater exposure if the new tube were installed, whereas the viewer would receive more exposure if the old tube were used.

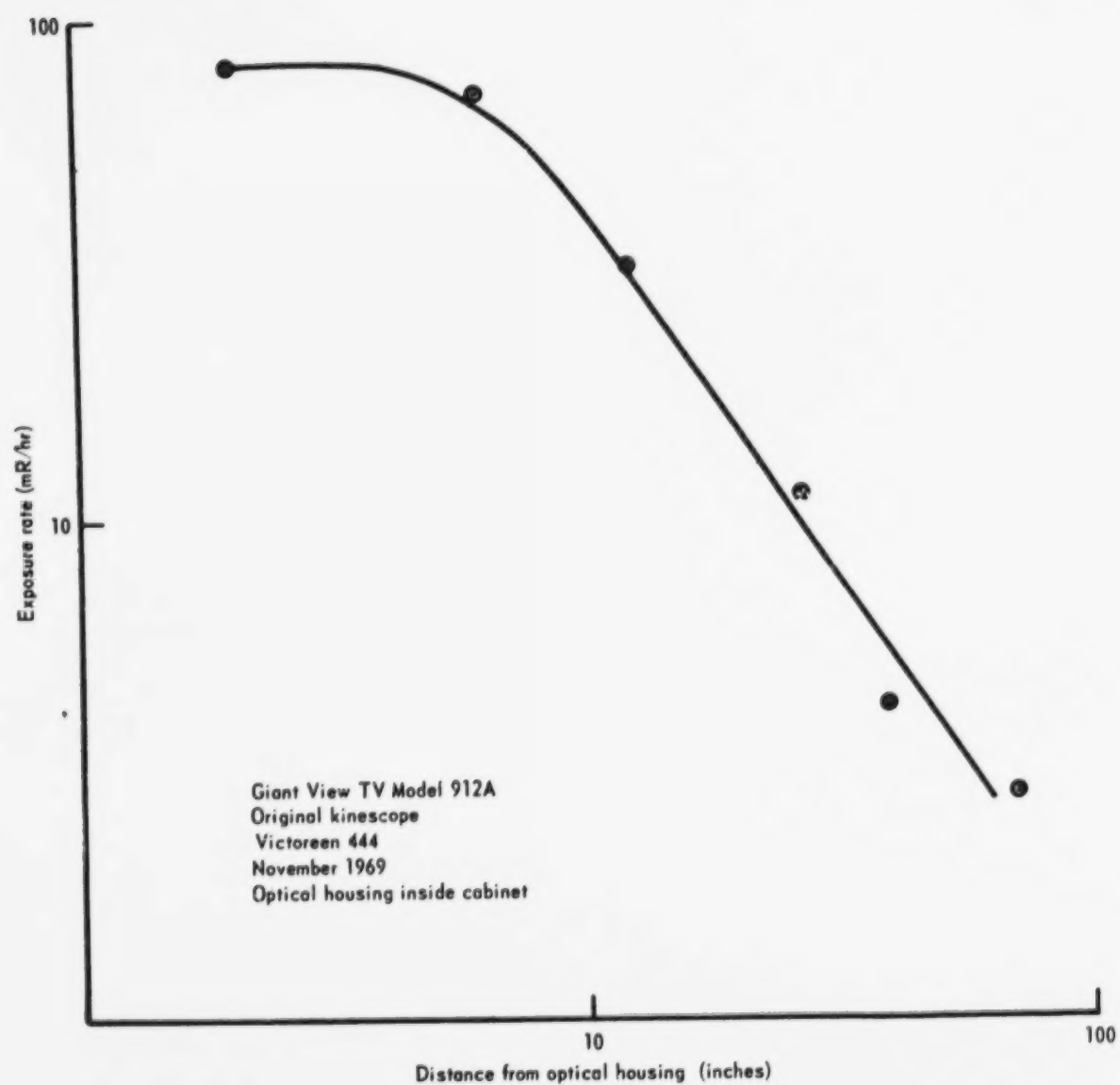


Figure 8. Exposure rate as a function of distance from the optical housing: optical housing inside cabinet, original kinescope

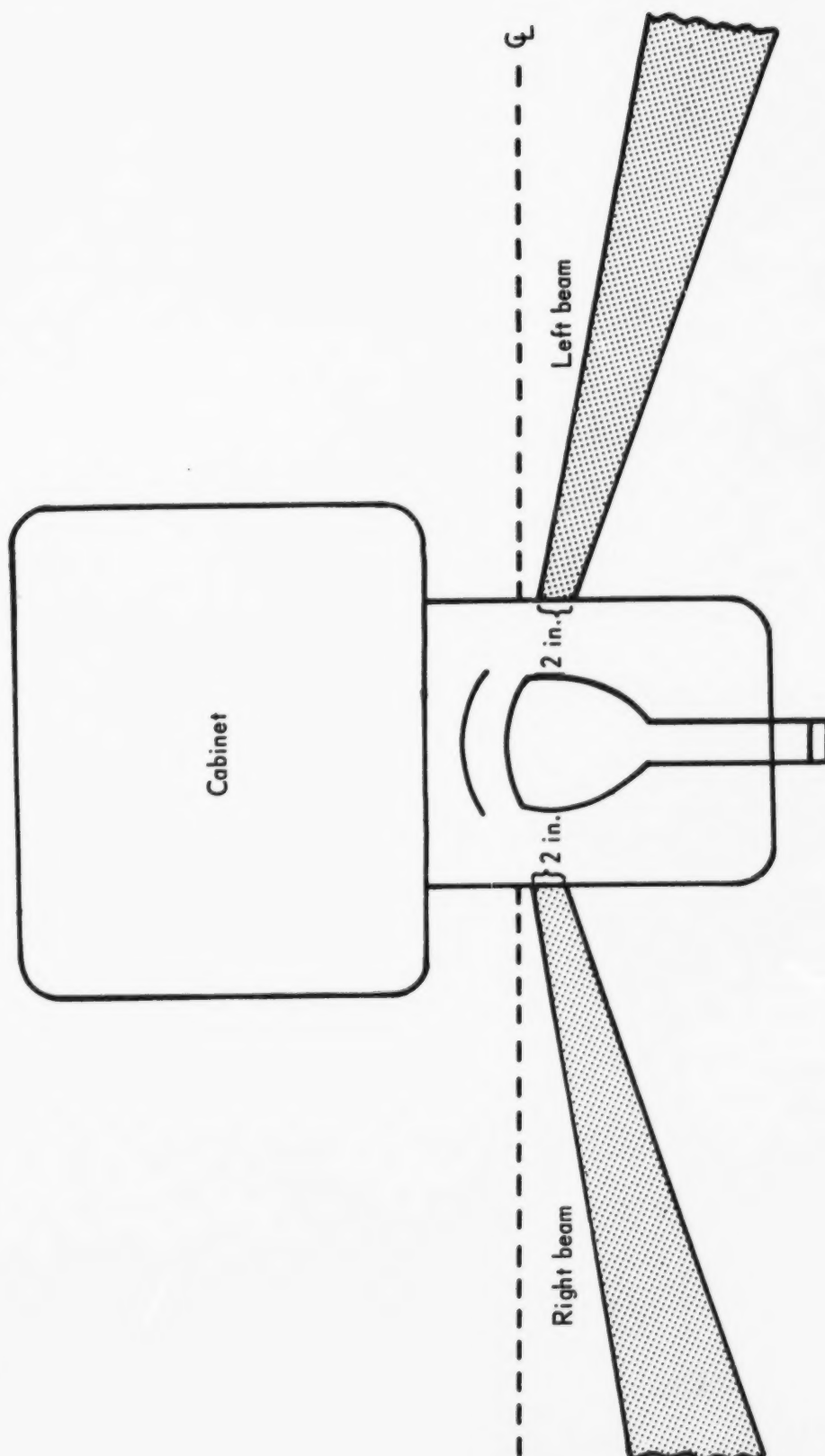


Figure 9. Area of uniform intense x radiation: optical housing outside cabinet, replacement kinescope

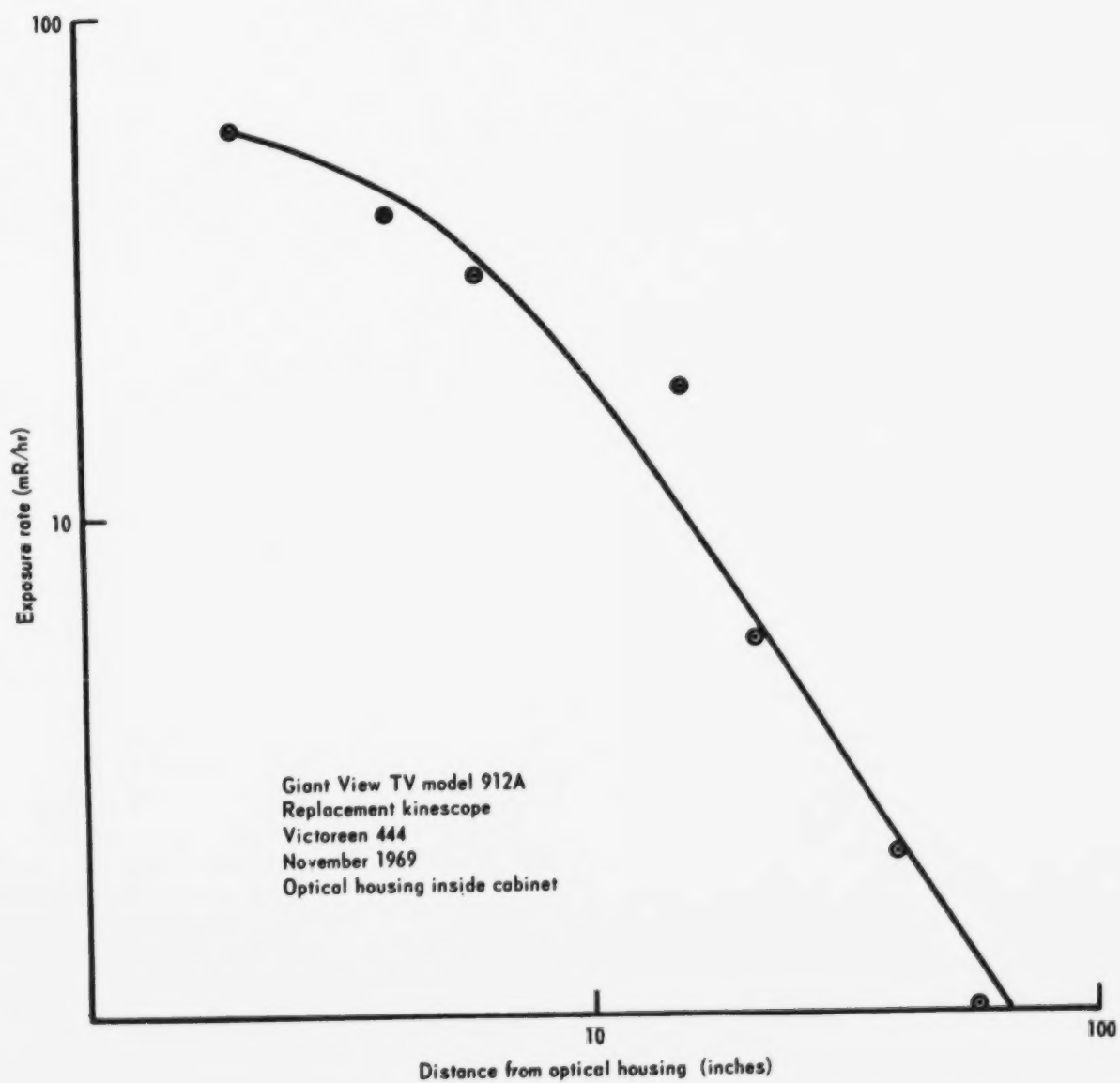


Figure 10. Exposure rate as a function of distance from the optical housing: optical housing inside cabinet, replacement kinescope

Table 4. - Right side regulation data with replacement kinescope and optical housing outside of the cabinet

High voltage control position	Line voltage (volts)	Kinescope current (milliamperes)	Kinescope voltage (kilovolts)	X radiation (mR/hr)
Max	120	0.44	33.8	61
	119	0.44	33.8	60
	118	0.42	33.7	58
	117	0.42	33.6	58
	120	0.40	27.8	6
	119	0.40	27.8	6
	118	0.40	27.8	6
	117	0.40	27.8	6
	120	0.54	22	0

4.2 RADIATION MEASUREMENTS -- OPTICAL HOUSING INSIDE CABINET

In this position the exposure rates found at the center of the upper door, operator's side, closed and open respectively, were 5.2 mR/hr and 16 mR/hr. These values again are somewhat higher than with the original tube installed. The Victoreen 440 RF/C and the 444 read 0.4 mR/hr from the 2-inch gap spaces on either side. The speaker holes had an emission rate of 0.8 mR/hr.

5. ANALYSIS OF DATA

In general, the field data mentioned in the Introduction to this report were verified, and all reports confirm that this unit was capable of emitting radiation exposure at rates of several hundred mR/hr. The values and locations of maximum emission reported do differ in all three reports, but this was expected since the slit-film technique for locating the actual source was not used by the field teams. Since radiation was

detected at the entire surface of optical housing when it was not in the cabinet, the position of the measuring instrument is critical if maximum readings are to be found. It must be remembered, also, that a very specific setting, including constant-signal input, produced maximum emission, and the field teams did not set up these conditions.

The tests have shown that essentially no area in front of the metal cabinet on the side from which the image is projected is free from some level of radiation. Paths of maximum radiation emerge from the sides of the optical housing when the unit is operated with the optical housing out of the cabinet. The level of emission is reduced, however, by at least a factor of 10 if the original kinescope is replaced with one that has a higher lead content, resulting in less exposure to the viewer. If this is done, essentially no radiation is emitted out the front of the unit but is confined to the side areas.

With the optical housing completely inside the cabinet and with the original kinescope in place, high levels of radiation were found to emanate from the 2-inch spaces on either side. With the replacement kinescope in place, these paths were reduced to very low levels. Both tubes were capable of emitting x rays through the hole where the fan is attached (see figure 11). These were observed on the operator's side of the cabinet centered in the optical housing area.

6. CONCLUSIONS AND RECOMMENDATIONS

The only practical solution to the problem of x-ray emission from the Giant View TV projector unit is to shield the kinescope with a high atomic number material. If the original tube were used, the material would have to be placed around the entire optical housing, including the lens. If the unit is to be used safely, replacement of the original kinescope with a leaded type is necessary and would allow removal of the front shield plate. The unit could be operated with the optical housing all the way inside the cabinet and with additional shielding added in back of the blower hole (operator's side) (see figure 12).

It is questionable whether many units of this particular model are operable today, because the test unit, even during the short period in which it was operated, needed replacement parts on four occasions. It was very difficult to locate three of the tubes.

Since this model unit, even with the leaded kinescope replacement, is capable of emitting high levels of x radiation (especially if the optical housing is not entirely inside the cabinet), users of this type device should carefully monitor for radiation, particularly if the unit is old and used in close proximity to viewers.

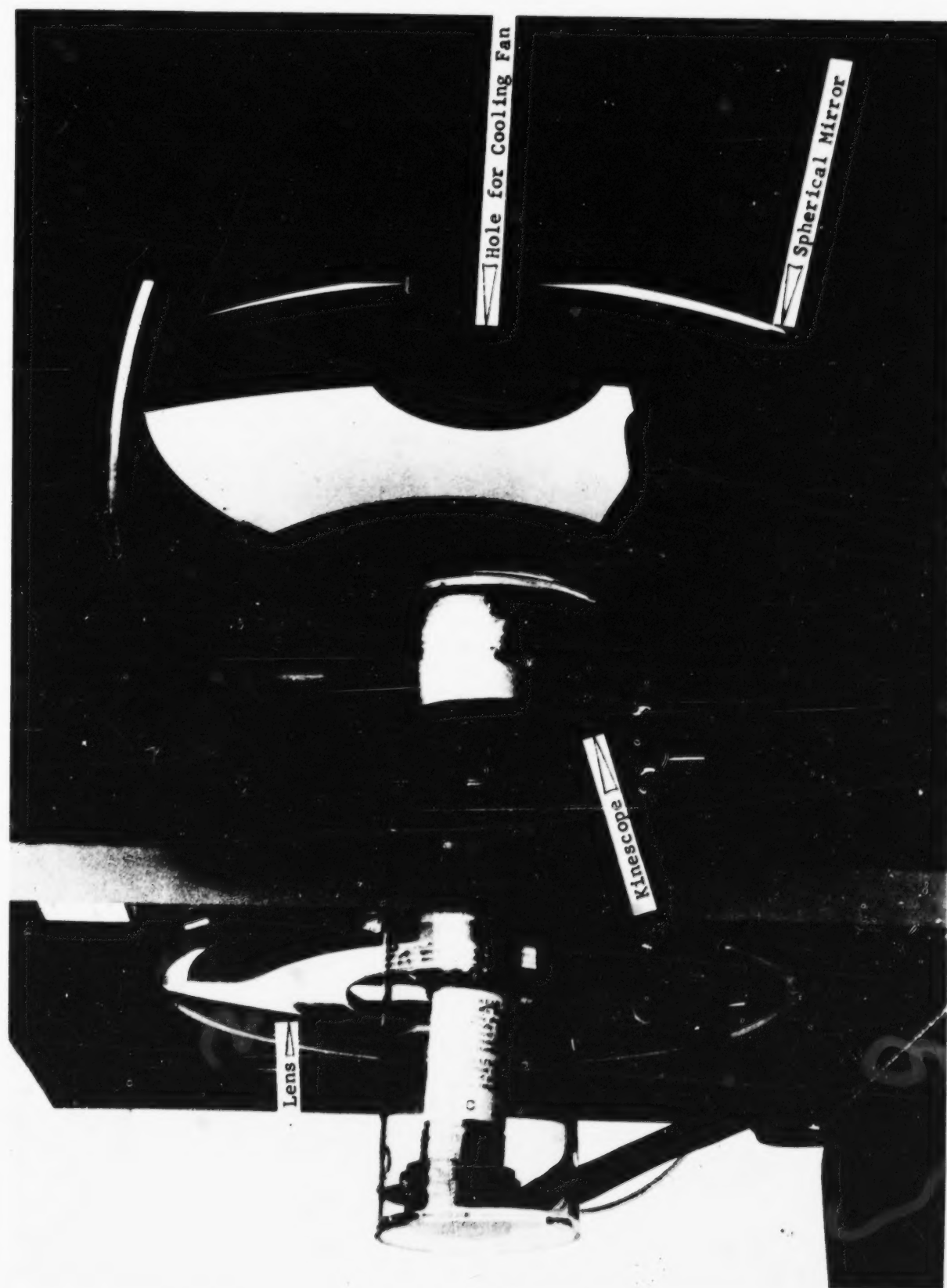


Figure 11. Closeup of optical housing

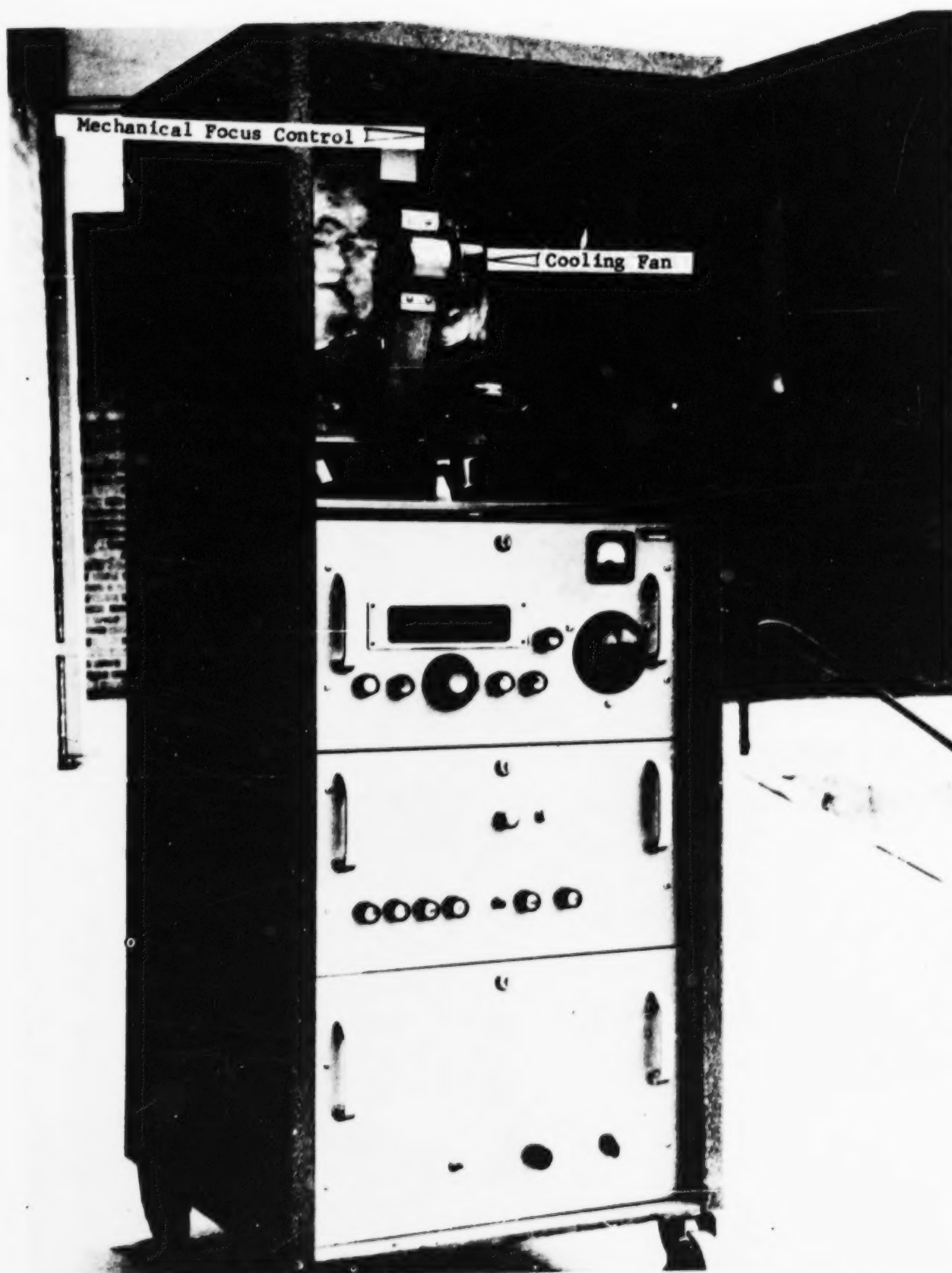


Figure 12. Giant View TV projector: upper door open, operator's side of unit

REFERENCES

1. RUGGERA, PAUL S., THOMAS M. SMITH, HENRY J. L. RECHEN, and CHARLES P. WARR. Anisotropic x-ray emission from internal electron tube structures. Fourteenth Annual Health Physics Society Meeting held in Pittsburgh, Pa., June 8-12, 1969 (unpublished).
2. LEVINE, HARRY and PAUL S. RUGGERA. A field method for the determination of lead in glass used for shielding television receiver components. Division of Electronic Products, Bureau of Radiological Health, Rockville, Md. (DEP Report 69-2) (December 1969).